NAME:

ECE344 Semiconductor Devices
Fall 2008

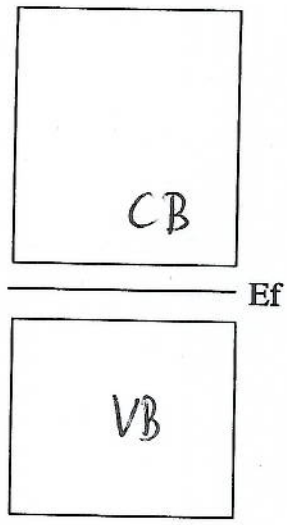
QUIZ-2

Question 1 (1.5 pts)
Associate (a) (b) (c) with one of the proposition (1), (2), or (3) for the resulting energy spectrum.
(a) free electron, (b) single atom, (c) crystal
(1) energy band, (2) continuum, (3) discrete

a_2
b_3
c_1

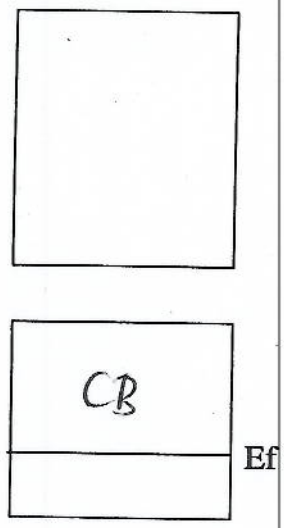
Question 2 (3 pts)
The following three diagrams show three different energy bands of some hypothetical crystalline materials. The only difference between the three materials is the assumed Fermi level energy E_F. Characterize each material as a **metal, insulator** or **semiconductor.** You will also specify **valence band (VB)** and **conduction band (CB).**

Material 1



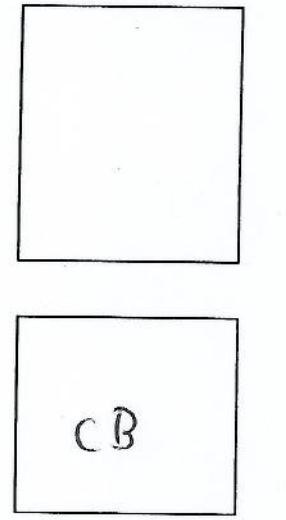
SC

Material 2



Metal

Material 3



Insula.

Question 3 (1.5 pts)
How does the conductivity of a material depend on whether the energy bands are completely filled, partially filled, or empty of electrons?
For the three different cases, circle one choice a,b,or c below

1-Empty band, a – (b) – c

2-Partially filled, (a) – b – c

3-Completely filled a – (b) – c

a- does contribute to the electrical conductivity
b- does not contribute to the electrical conductivity
c- not enough information provided

Question 4 (1 pt)
What are holes? Carefully justify your definition.

→ * holes are missing $\bar{e}$ [they account for the collective behavior of all $\bar{e}$]

→ * holes are positively charged (fictive) particle. h^+

Question 5 (3 pts)
Let us consider a semiconductor material, are the following definitions for the Fermi level E_F **True or False** ?
Circle one choice below:

a-At T=0, it is the energy level that lies between VB and CB
(True) – False

b-At T=0, it is the maximum energy level that can take an electron
True - (False)

c-At T=0, all the energy levels below E_F will be occupied
(True) – False

d-At T>0, there will be 50% of chance to find an electron at E_F
True – (False)

Among the definitions a, b, c, d, which one is the most general definition of the Fermi level (for any type of materials or systems)?

c